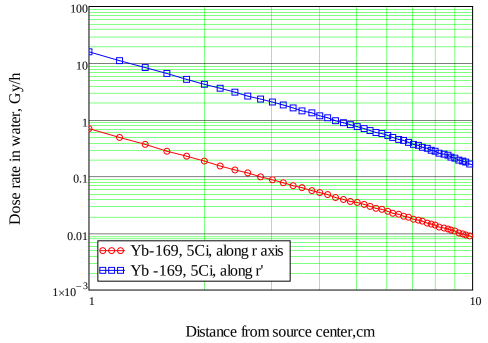
We created an AVLIS facility for the production of primary isotope Yb-168 with the enrichment above 20% and with a record capacity. In order to increase the activity and improve mechanical properties of ytterbium sources, we developed the technology of ytterbium ceramics production. The design of new compact source loader with ceramic ytterbium sources is now in progress.



Keywords: brachytherapy, ytterbium source

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Conformal proton therapy with passive scattering

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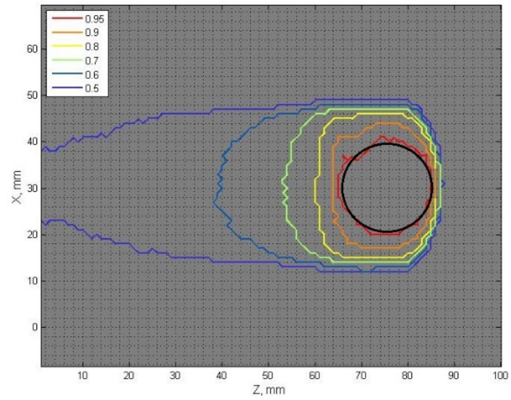
In proton therapy, as well as in carbon ion therapy, two main methods of dose distribution formation can be used: the passive particle scattering and the particle scanning in several modifications. The pencil-beam scanning is now considered as a most advantageous method of dose distribution formation. Indeed, this method provides the conformance of dose delivery to a tumor of any size with no significant dose, delivered to healthy surrounding tissue. However, in some cases the beam scanning method may have problems. In particular, this is the case of small targets when the pencil beam width is comparable with the target size. The eye melanoma and small brain metastasis may be examples of such small tumors.
In these cases the application of the old method of passive beam scattering with a formation of individual dose distributions may be reasonable. However, this method in its classical version with a ridge filter, a bolus and a collimator is known to fail to provide the sufficiently conformal dose distribution with one field: either the maximal dose significantly exceeds the tumor volume on its proximate site or the dose value changes too much within the tumor volume.
We found a new construction of a two-component ridge filter which provides the dose distributions with no mentioned above shortcomings (the corresponding patent is pending). We have performed a series of calculations with the help of the original Monte-Carlo code SRNA in order to find the optimal construction of new ridge filters from the point of view of dose distribution accuracy and of the device manufacturability. In the figure the example of dose distribution calculated with the SRNA program is presented. As it follows from the figure, even with one field the 95% isodose line does not notably leave the tumor volume, represented by the black circle. The usual "wings" on proximate side of lower isodose lines are absent as well. The experimental tests of these new devices with proton beams of the INR linac are now in progress.



Keywords: proton therapy

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Commissioning of a Compton camera for ion beam range verification via prompt γ detection using low-energy and clinical particle beams

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Purpose: Recently, the interest of using hadron-therapy in cancer treatment, particularly for tumors in the vicinity of critical organs-at-risk, has grown due to the ability of providing high precision dose delivery. In order to fully exploit this feature, a precise monitoring of particle beam (proton, ions) is mandatory. Therefore, the purpose of our project is to develop an online imaging system based on a Compton camera to verify the particle beam (proton, ions) range by detecting prompt γ rays, induced as a result of nuclear reactions between the particle beam and biological tissue.
Material / Methods: The Compton camera consists of two main components: a scatterer (tracker), formed by a stack of six customized double-sided Si-strip detectors (DSSSD), and a monolithic $LaBr_3$ scintillation detector (50x50x30 mm^3) acting as an absorber detector. The DSSSD detector is processed by a compact ASIC based electronics, while the $LaBr_3$ detector is read out by a position-sensitive (16x16) multi-anode photomultiplier (PMT, Hamamatsu H9500), whose segments are processed individually using spectroscopy electronics. The energy and timing signals are digitized in a VME-based charge-to-digital converter and time-to-digital converter, respectively.
Results: The Compton camera components have been characterized in the laboratory using calibration sources. The time and energy resolution of the $LaBr_3$ detector were measured to be 273 ± 6 ps (FWHM) and 3.5%, using ^{60}Co and